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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

JAMES A. HILL

Serial No.: 10/623,997

Filed: July 21, 2003

For: ACOUSTIC TRANSDUCER

Attorney Docket No.: HORI 0130 PUS

Group Art Unit: 5480

Examiner: Tamiko D. Bellamy

APPEAL BRIEF UNDER 37 C.F.R. § 41.37

Mail Stop Appeal Brief - Patents
Commissioner for Patents
U.S. Patent & Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This is an Appeal Brief in support of the appeal from the final rejection of claims 1-23 in the Office Action mailed on September 1, 2005.

I. REAL PARTY IN INTEREST

The real party in interest is Horiba Instruments, Inc. ("Assignee"), a corporation organized and existing under the laws of the state of California, and having a place of business at 17671 Armstrong Avenue, Irvine, California 92714, as set forth in the assignment recorded in the U.S. Patent and Trademark Office on July 21, 2003 at Reel 014317/Frame 0337.

CERTIFICATE OF MAILING UNDER 37 C.F.R. § 1.8 (FIRST CLASS MAIL)

I hereby certify that this paper, including all enclosures referred to herein, is being deposited with the United States Postal Service as first-class mail, postage pre-paid, in an envelope addressed to: Mail Stop Appeal Brief - Patents, Commissioner for Patents, U.S. Patent & Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450 on:

January 25, 2006	Jeremy J. Curcuri	Jeremy J. Curcuri
Date of Deposit	Name of Person Signing	Signature

II. RELATED APPEALS AND INTERFERENCES

There are no appeals or interferences known to the Appellant, the Appellant's legal representative, or the Assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 1-27 are pending in this application. Claims 24-27 have been withdrawn from consideration. Claims 1-23 have been rejected and are the subject of this appeal.

IV. STATUS OF AMENDMENTS

A response after final rejection was filed on September 12, 2005. The response did not amend the application.

V. SUMMARY OF CLAIMED SUBJECT MATTER

The invention relates to acoustic transducers, including those used in flow meters. Page 1, lines 4-5.

Transmitting pulses of acoustic energy through a fluid is useful for measuring the state and properties of the fluid, specifically the velocity and temperature. Piezoceramic elements are commonly used in acoustic transducers to generate ultrasonic acoustic pulses or continuous wave fields. However, these ceramics lose polarization if exposed to temperatures in excess of half of their Curie point. For commercially available ceramics, this limits the operating temperature of the ceramic to under 200°C. To operate in fluids above this temperature, one method is to provide a buffer or delay line between the piezoceramic element and the fluid (for example, exhaust gas). Page 1, lines 7-15.

A disadvantage associated with existing buffer systems is that a short buffer has problems when operating with hot fluids, while making the buffer longer requires that the

buffer guide the wave front in the desired direction. Further, solid buffers fail to effectively guide the acoustic pulse resulting in a dispersive buffer that distorts the ultrasonic pulse and limits the usefulness of the flow meter. Page 2, lines 6-10.

Figure 3 illustrates an acoustic transducer made in accordance with the invention, and Figure 4 illustrates an electrical equivalent circuit of the acoustic transducer arrangement shown in Figure 3.

Claim 1 recites an acoustic transducer 30 for measuring a property of a fluid. The acoustic transducer 30 comprises an acoustic pulse generator 32, an impedance matching layer 34, and a thermal management system 37. The impedance matching layer 34 is between the pulse generator 32 and the fluid. The matching layer 34 is formed of a low thermal conductivity material. The impedance matching layer 34 has a reduced length to the point where traveling waves are no longer present. The thermal management system 37 is mounted to the matching layer 34 to transfer heat from the matching layer 34. The thermal management system 37 is formed of a high thermal conductivity material relative to the matching layer 34 and is arranged along the matching layer 34 such that substantial heat is transferred to the environment from the thermal management system 37 without excessive temperature increase at the pulse generator 32. Page 2, line 19 - page 3, line 5; page 3, lines 7-11; and page 6, line 2-page 7, line 11.

Claim 14 recites an acoustic transducer 30 for measuring a property of a fluid. The acoustic transducer 30 comprises an acoustic pulse generator 32, an impedance matching layer 34, and a thermal management system 37. The impedance matching layer 34 is between the pulse generator 32 and the fluid. The matching layer 34 is formed of a material with a thermal conductivity less than 1 W/(m·K). Page 3, lines 16-17.

Claim 14 specifically recites that the thermal management system includes a sleeve 37 over the matching layer 34 to transfer heat from the matching layer 34. The thermal management system 37 is formed of a high thermal conductivity material relative to the matching layer 34 and is arranged along the matching layer 34 such that substantial heat is transferred to the environment from the thermal management system 37 without excessive temperature increase at the pulse generator 32. Page 6, lines 10-15.

Claim 23 recites an acoustic transducer 30 provided in combination with an apparatus including a conduit through which a fluid flows. The apparatus may be an exhaust gas sampling or testing apparatus. Figure 6 illustrates flow meter 64, showing a pair of acoustic transducers 30 arranged in an opposed fashion across a conduit. Page 4, lines 10-13; page 7, lines 28-29.

Claim 23 recites an acoustic transducer 30 for measuring a property of a fluid. The acoustic transducer 30 comprises an acoustic pulse generator 32, an impedance matching layer 34, and a thermal management system 37. The impedance matching layer 34 is between the pulse generator 32 and the fluid. The matching layer 34 is formed of a low thermal conductivity material. The impedance matching layer 34 has a reduced length to the point where traveling waves are no longer present. The thermal management system 37 is mounted to the matching layer 34 to transfer heat from the matching layer 34. The thermal management system 37 is formed of a high thermal conductivity material relative to the matching layer 34 and is arranged along the matching layer 34 such that substantial heat is transferred to the environment from the thermal management system 37 without excessive temperature increase at the pulse generator 32. Page 2, line 19 - page 3, line 5; page 3, lines 7-11; and page 6, line 2-page 7, line 11.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1-23 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Suzuki et al. (U.S. Publication No. 2002/0124662) in view of Daire et al. (U.S. Patent No. 5,440,930).

VII. ARGUMENT

A. Claims 1-23 Are Patentable Under 35 U.S.C. § 103(a) Over Suzuki in view of Daire

Suzuki describes an ultrasonic transducer and flow meter. Suzuki adopts a short buffer approach and is directed specifically to transducer manufacture. The Examiner acknowledges that Suzuki is deficient in that the claimed thermal management system is not suggested by Suzuki.

Daire describes an ultrasonic measuring assembly and means for attaching the assembly to a vessel. There is no motivation to combine Suzuki and Daire to achieve the claimed invention.

In the final action, the Examiner states that "as long as some motivation or suggestion to combine the references is provided by the prior art taken as a whole, the law does not require that the references be combined for the reasons contemplated by the inventor."

The issue is not whether one of ordinary skill in the art would consider combining teachings of Suzuki and Daire, the issue is whether one of ordinary skill in the art would be motivated to combine teachings of Suzuki and Daire to achieve the claimed invention. The Examiner maintains that one of ordinary skill in the art would consider combining teachings of the two references. Applicant maintains that, without regard to whether one of

ordinary skill in the art would consider the two references, there is no motivation to combine Suzuki and Daire *to achieve the claimed invention.*

Regarding Daire, in the illustrated embodiment, Daire describes simultaneously clamping the emitter 13 and receiver 14 against the spacers 11 and 12. As shown, the spacers 11, 12 are formed of a thermally conductive material and thin air cooling fins 20 are formed on the outer periphery of each spacer. As clearly depicted in Figures 1 and 2, the spacers 11 and 12 function as longer buffers as they sit between the transducers and the pipe 10 and are shaped in a way that would not effectively guide the wave front. As well, the overall assembly is clamped to the outside of pipe 10 resulting in further buffering of the pulses, limiting the usefulness of this flow meter.

It is not clear that any of the teachings of Daire would be readily usable in the short buffer approach of Suzuki *in a way that would achieve the claimed invention.* Specifically, it is not clear that any of the teachings of Daire would be readily usable in the short buffer approach of Suzuki without resulting in a longer buffer due to the fact that the spacers in Daire sit between the transducers and the pipe.

Claim 1, for example, specifically recites various limitations including "an impedance matching layer between the pulse generator and the fluid" and "the thermal management system . . . arranged along the matching the layer such that substantial heat is transferred to the environment from the thermal management system without excessive temperature increase at the pulse generator." Even if an attempt is made to combine the thermal management system in Daire with the ultrasonic transducer in Suzuki, *any such combination would still fail to suggest the claimed invention.* Adapting the thermal management system of Daire to Suzuki would result in a longer buffer approach, and no longer meet the recited claim limitation of "an impedance matching layer between the pulse generator and the fluid" while at the same time meeting the claim limitation "the thermal management

system . . . arranged along the matching layer such that substantial heat is transferred to the environment from the thermal management system without excessive temperature increase at the pulse generator." Thus, the combination proposed by the Examiner fails to meet *all* claim limitations.

In an attempt to provide evidence of motivation to combine the references to achieve the claimed invention, the Examiner states that "the skilled artisan would be motivated to combine the teachings of Suzuki et al. and Daire et al. since Suzuki et al. states that his invention is applicable to an ultrasonic transducer that carries out a flow rate measurement through which fluid flows and Daire et al. is directed to ultrasonic flow meter using an ultrasonic transducer."

The issue is not whether it would be possible to combine teachings from the two references, the issue is whether there is motivation to combine teachings *to achieve the claimed invention*. Even if the thermal management system of Daire were used in the ultrasonic transducer of Suzuki, such a combination would not meet *all* limitations recited by the claims. After all, such a combination would effectively be attempting a longer buffer approach where the longer buffer is composed of the pipe wall and spacer.

1. Claim 14 Is Separately Patentable Under 35 U.S.C. § 103(a) Over Suzuki in view of Daire

Claim 14 recites an acoustic transducer for measuring a property of a fluid, and specifically recites that the matching layer is formed of a material with a thermal conductivity less than 1 W/(m·K) and that the thermal management system includes a sleeve over the matching layer to transfer heat from the matching layer. Regarding the limitation of the "sleeve over the matching layer," the cited prior art fails to suggest the recited arrangement of the thermal management system including the sleeve. Daire does mention, in column 2 at lines 36-39 that one of the ends of the aluminum cylinder heat exchange structure may be

hollowed out in order to make a cavity intended to receive the emitter or the receiver. Nevertheless, Daire only suggests the reception of the emitter or receiver in a cavity of the heat exchange structure. The cavity arrangement mentioned by Daire does not suggest the sleeve arrangement claimed by Appellant. As exemplified in Figure 3 of the present application, the sleeve is arranged over the matching layer with the matching layer being between the pulse generator and the fluid. Daire only mentions putting the emitter or receiver in a cavity of the heat exchanger which still makes no suggestion of the claimed sleeve arrangement.

2. Claims 12 and 21 Are Separately Patentable Under 35 U.S.C. § 103(a) Over Suzuki in view of Daire

Claims 12 and 21 further recite that, during operation, at least a portion of the matching layer sides and the matching layer tip extend into the fluid which is being measured, and the thermal management system is arranged to insulate the portion of the matching layer sides from the heat from the fluid while the leaving the tip of the matching layer in contact with the fluid.

Daire, at most, mentions that the emitter or receiver can be received in a cavity of the heat exchanger. Such an arrangement does not result in a portion of the matching layer sides and tip extending into the fluid which is being measured, with the thermal management system insulating the portion of the matching layer sides from the heat from the fluid while leaving the tip of the matching layer in contact with the fluid.

3. Claims 13 and 22 Are Separately Patentable Under 35 U.S.C. § 103(a) Over Suzuki in view of Daire

Claims 13 and 22 further recite that the insulated portion of the matching layer sides is insulated by an air gap formed by the thermal management system. For example, metal shield 38 in Figure 3 forms the air gap. These claims are also believed to be separately patentable. Daire, at most, mentions that the emitter or receiver can be received in a cavity of the heat exchanger. Such an arrangement does not suggest a workable way to use the

thermal management system with a portion of the matching layer sides and the tip extending into the fluid, let alone suggest insulating the matching layer sides by an air gap formed by the thermal management system.

The fee of $500.00 as applicable under the provisions of 37 C.F.R. § 41.20(b)(2) is enclosed. Please charge any additional fee or credit any overpayment in connection with this filing to our Deposit Account No. 02-3978.

Respectfully submitted,

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Enclosure - Appendices

VIII. CLAIMS APPENDIX

1. An acoustic transducer for measuring a property of a fluid, the acoustic transducer comprising:

an acoustic pulse generator;

an impedance matching layer between the pulse generator and the fluid, the matching layer being formed of a low thermal conductivity material, the impedance matching layer having reduced length to the point where traveling waves are no longer present; and

a thermal management system mounted to the matching layer to transfer heat from the matching layer, wherein the thermal management system is formed of a high thermal conductivity material relative to the matching layer and is arranged along the matching layer such that substantial heat is transferred to the environment from the thermal management system without excessive temperature increase at the pulse generator.

2. The acoustic transducer of claim 1 wherein the matching layer thermal conductivity is less than 15 W/(m·K).

3. The acoustic transducer of claim 1 wherein the matching layer thermal conductivity is less than 1 W/(m·K).

4. The acoustic transducer of claim 1 wherein the matching layer is made of foam silica.

5. The acoustic transducer of claim 1 wherein the matching layer is made of silica.

6. The acoustic transducer of claim 1 wherein the thermal management system thermal conductivity is at least 15 W/(m·K).

7. The acoustic transducer of claim 1 wherein the thermal management system thermal conductivity is at least 100 W/(m·K).

8. The acoustic transducer of claim 1 wherein the pulse generator is configured to operate at a particular frequency and wherein the matching layer has a thickness approximately equal to an odd multiple of the quarter wavelength of sound in the matching layer for the particular frequency of the pulse generator.

9. The acoustic transducer of claim 1 wherein the thermal management system includes a plurality of fins.

10. The acoustic transducer of claim 1 wherein the acoustic generator is a piezoceramic element for generating an ultrasonic pulse.

11. The acoustic transducer of claim 1 wherein the matching layer has a surface coating in contact with the fluid which is being measured.

12. The acoustic transducer of claim 1 wherein during operation at least a portion of the matching layer sides and the matching layer tip extend into the fluid which is being measured, and wherein the thermal management system is arranged to insulate the portion of the matching layer sides from heat from the fluid while leaving the tip of the matching layer in contact with the fluid.

13. The acoustic transducer of claim 12 wherein the insulated portion of the matching layer sides is insulated by an air gap formed by the thermal management system.

14. An acoustic transducer for measuring a property of a fluid, the acoustic transducer comprising:

an acoustic pulse generator;

an impedance matching layer between the pulse generator and the fluid, the matching layer being formed of a material with a thermal conductivity less than 1 W/(m·K); and

a thermal management system including a sleeve over the matching layer to transfer heat from the matching layer, wherein the thermal management system is formed of a high thermal conductivity material relative to the matching layer and is arranged along the matching layer such that substantial heat is transferred to the environment from the thermal management system without excessive temperature increase at the pulse generator.

15. The acoustic transducer of claim 14 wherein the thermal management system thermal conductivity is at least 15 W/(m·K).

16. The acoustic transducer of claim 14 wherein the thermal management system thermal conductivity is at least 100 W/(m·K).

17. The acoustic transducer of claim 14 wherein the pulse generator is configured to operate at a particular frequency and wherein the matching layer has a thickness approximately equal to an odd multiple of the quarter wavelength of sound in the matching layer for the particular frequency of the pulse generator.

18. The acoustic transducer of claim 14 wherein the thermal management system includes a plurality of fins extending outwardly from the sleeve.

19. The acoustic transducer of claim 14 wherein the acoustic generator is a piezoceramic element for generating an ultrasonic pulse.

20. The acoustic transducer of claim 14 wherein the matching layer has a surface coating in contact with the fluid which is being measured.

21. The acoustic transducer of claim 14 wherein during operation at least a portion of the matching layer sides and the matching layer tip extend into the fluid which is being measured, and wherein the thermal management system is arranged to insulate the portion of the matching layer sides from heat from the fluid while leaving the tip of the matching layer in contact with the fluid.

22. The acoustic transducer of claim 21 wherein the insulated portion of the matching layer sides is insulated by an air gap formed by the thermal management system.

23. In combination with an apparatus including a conduit through which a fluid flows, the improvement comprising:

an acoustic transducer for measuring a property of a fluid, the acoustic transducer including an acoustic pulse generator, an impedance matching layer, and a thermal management system, the impedance matching layer being between the pulse generator and the fluid, the matching layer being formed of a low thermal conductivity material, the impedance matching layer having reduced length to the point where traveling waves are no longer present, and the thermal management system being mounted to the matching layer to transfer heat from the matching layer, wherein the thermal management system is formed of a high thermal conductivity material relative to the matching layer and is arranged along the matching layer such that substantial heat is transferred to the environment from the thermal management system without excessive temperature increase at the pulse generator.